

In-situ observation of liquid immiscibility in the Fe-O-S melts at high pressure using an X-ray radiographic technique

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Liquid immiscibility in the liquid Fe with light elements at high pressure is important for discussing formation, chemical composition, and structure of the Earth and planetary cores. In previous studies, a liquid immiscibility gap of Fe-O melt (Kato and Ringwood 1989; Ringwood and Hibberson 1990), Fe-O-S melt (Urakawa et al. 1987; Tsuno et al. 2007), and Fe-S-Si melt (Sanloup and Fei 2004) at high pressure have been investigated. However, these results were based on textural observation and chemical analysis of the recovered products using a SEM and an electron microprobe. In this study, we performed an in-situ observation of the Fe-O-S melts using an X-ray radiographic technique, and determined a precise liquid immiscibility gap at 3 GPa and up to 2203 K.

Experiments were carried out using the 1500 ton multianvil press (SPEED-1500) at BL04B1 beamline, SPring-8, and 700 ton press (MAX-III) at BL14C2 beamline, KEK-PF. For X-ray radiographic measurements, we used a white X-ray at SPring-8, and a 35 keV monochromatic X-ray at KEK-PF. We used fine starting materials of mixtures of Fe, FeS, and Fe_{0.91}O. They were enclosed in an alumina sample container. During the in-situ measurements, we clearly observed the difference in image between two immiscible melts and a single miscible melt using a CCD camera. We found that the liquid immiscibility gap shrinks with increasing temperature at 3 GPa.